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# Financial Analysis for Replacement of Construction Equipment in Saudi Arabia

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## ABSTRACT

This study report results of a survey conducted in the Eastern Province of Saudi Arabia to explore the procedures and financial techniques that large-size contractors utilise in replacing equipment. The results indicated that contractors set several replacement alternatives that they evaluate by using a set of various qualitative and quantitative factors. The contractors' business objectives, employee safety and morale, and, contractors' image in the industry were found to be the most influential qualitative factors affecting the decision of equipment replacement. Inflation, downtime, obsolescence, salvage value, and depreciation are among the top quantitative factors that contractors consider while making a decision to replace equipment. Because of their simplicity and practicality, the net present value, payback period, and the economic life are the most popular techniques that are utilised for analysing the financial issues of proposed replacement alternatives.

Keywords: replacement, construction equipment, financial analysis, depreciation, Saudi Arabia.

## INTRODUCTION

The cost of equipment constitutes a major investment for most construction contractors in Saudi Arabia. Contractors need to develop procedures and policies to manage their equipment properly, and to aid them in making decisions concerning their ownerships and operations. The replacement of equipment is a major decision that a contractor has to face regularly during the equipment's life span. Advanced technologies often make equipment replacement an attractive option. New models promise lower cost, better quality, greater capacity, and ease of operation. However, replacement decisions may have serious effect on the firm's liquidity, operational flexibility, and profits. If a contractor replaces equipment earlier than its expected time, the firm will lose money due to the premature replacement of equipment. If the purchase had been delayed, the money could have been invested elsewhere. On the other hand, if the replacement is delayed, then operation and maintenance costs might increase dramatically and additional overhead might be required, and the salvage value might be less beneficial than desired. Alternatively, if the equipment was to fail during this period, the firm could face heavy financial losses, delayed schedules, and additional funds would be required to either quickly repair the equipment or purchase a new one.

Contractors are expected to follow certain procedures for replacing their equipment. These procedures are either detailed as part of a comprehensive manual, or as a separate policy that contractors adopt to purchase new equipment and to replace the old ones. The replacement policy is expected to aid contractors in choosing the best replacement alternative that maximises the total profit and reduces the expenses and losses. Contractors need such a policy to replace inefficient equipment, or to add equipment to satisfy the growing demand.

Although the construction industry in Saudi Arabia is the second largest industry, after the oil industry, researchers have not addressed subjects related to the ownership and replacement of equipment in this industry. Shash and Shuaib (2003) are among the first researchers who addressed equipment management practices in general among construction contractors in Saudi Arabia. This study was conducted to study the practices that contractors follow in replacing their construction equipment.

## DATA COLLECTION

The study data was collected from construction contractors in the Eastern Province of Saudi Arabia through a mail survey. A structured questionnaire, which was divided into six sections, was used as a tool for collecting the needed data. The study performed by Tavakoli et al. (1989) set the foundation for developing the structured questionnaire. The first section consisted of questions seeking information for describing the current replacement policy used by firms in evaluating their equipment, and deciding on the best replacement time and alternative. The second section contained questions for identifying the financial techniques used to evaluate the replacement proposals. The third section presented a list of potential factors influencing the replacement decision. The fourth section consisted of questions seeking the details of the replacement techniques that are used to evaluate the equipment replacement proposals, and factors influencing the replacement decision. The last two sections were aimed to obtain miscellaneous information regarding the equipment records, and maintenance which were used during the replacement process.

## POPULATION AND SAMPLING

The Ministry of Housing and Public Works classifies construction contractors into several grades (Grade I, II, III, IV ….). Contractors of the top grades (Grades I, II, and III) were considered for the study population. Contractors who undertake annual work volume of SR 1 to 100 million are classified as Grade III, those with annual work volume between SR 100 and SR 200 million are classified as Grade II, and contractors whose annual work volume is above SR 200 million are classified as Grade I. There are 70 contractors in those grades in the Eastern Province of Saudi Arabia and the questionnaire was mailed to all of them due to the small size of the population. Despite the telephonic and personal follow-up only twenty-one contractors, representing 30% of the total population, responded and mailed or faxed back the completed questionnaire. This number of respondents is considered sufficient to represent the population.

### Characteristics of the Participants

The participants are building (including commercial and residential), road (including highways and inter-city roads), industrial, electrical, and mechanical contractors who are well experienced and well-established in the construction industry for

many years. Their work experience ranges between 15 and 50 years with an average experience of 26 years. These contractors perform annual work volume ranging between SR 8 million to SR 412 million with an average of SR 80.35 million (SR 3.75 equals one US dollar). The distribution of contractors according to their grades is presented in Table 1. It should be noted that the annual work volume of Grade I contractors is the highest, and ranges between SR 300 and 412 million, and that 14 participants have an annual work volume below the average, and 6 participants have an annual work volume above the average.

| Annual Work Volume | Number of Contractors | Percent |
|---|---|---|
| Value not indicated | 1 | 4.76 |
| Grade 3: 1-100 Million SR | 14 | 66.67 |
| Grade 2: 101-200 Million SR | 3 | 14.29 |
| Grade 1: Above 200 Million SR | 3 | 14.29 |

*Table 1:* Contractors' annual volume of work

The participants own equipment which are valued between SR 72,000 to SR 250 million with an average value of SR 54.185 million. It is noted that the value of a contractor's equipment increases with size. Grade I contractors have fleet with the highest value and the majority of grade II contractors have a fleet value between SR 10 to 35 million, while the majority of grade III contractors have a fleet value ranging between SR 1 to 10 million. The contractors own between 30 to 100% of the fleet with an average of 83.29%. This high level of ownership might be due to the fact that leasing and renting construction equipment are not commonly practiced in Saudi Arabia.

The fact that the data for this study was obtained from experienced contractors, who execute sizable volumes of work, provides credibility and reliability to the obtained results.

## Analysis of Equipment Replacement Proposals

The analysis of obtained information indicates that contractors follow systematic procedures when making a decision to replace equipment. Once a contractor decides to evaluate the need for replacing existing equipment or to buy a new one, he forms a team of experts to prepare a proposal for selecting the course of action. The team, then, performs the evaluation based on predefined objectives that are set by the organisation. The team usually follows a systematic approach to prepare the needed proposal.

## Identification of Alternative Proposals

The survey indicated that the majority (more than 50%) of the participants consider the following alternatives when they contemplate equipment replacement:

1. Remodel present equipment
2. Purchase new equipment
3. Purchase used equipment
4. Continue with existing equipment

The team collects, from vendors and their own records, all the necessary technical and financial data for each alternative and, then, analyses these data to reach to a substantiated conclusion and recommendation. The alternative that maximises the profit and reduces expenses and losses is always recommended.

In its evaluation, the team studied subjective or qualitative and quantitative factors that are considered to influence the equipment replacement and need decisions. The subjective or qualitative factors are those which have no sensible money value but have a direct effect on the company's image in the industry, the employees' morale, and the environment. The quantitative factors are those that have an impact on the company's total cost and profit.

## Qualitative Factors Influencing Replacement Analysis

The contractors evaluate subjective or qualitative factors including employees' morale, employees' safety, environmental responsibility, their image in the industry and the management goals when making equipment replacement decisions. The contractors assign a different degree of importance to each of these factors as shown in Table 2. The values in the sum column are equated by multiplying the score by the influencing value on the top of each column to normalise the effects of factors.

| Qualitative Evaluation Factor | Score | | | | | Sum | Rank |
|---|---|---|---|---|---|---|---|
| | VMJI | MJI | MNI | VMNI | NI | | |
| | 5 | 4 | 3 | 2 | 1 | | |
| Employee Morale | 5 | 2 | 8 | 4 | 1 | 66 | 4 |
| Employee Safety | 5 | 13 | 2 | 1 | 0 | 85 | 2 |
| Environmental Responsibility | 1 | 4 | 10 | 4 | 1 | 60 | 5 |
| Image in Industry & among others | 6 | 11 | 1 | 1 | 1 | 80 | 3 |
| Management Goals | 15 | 4 | 2 | 0 | 0 | 97 | 1 |

*VMJI: Very Major Influence, MJI: Major Influence, MNI: Minor Influence, VMNI: Very Minor Influence, NI: No Influence*

*Table 2:* Qualitative evaluation factors

Since the primary aim of any business organisation is making profit on its investment, the goals of management are ranked highly and heavily considered when making a replacement decision. It is not surprising, then, to see contractors give a substantial consideration to their human resources, in terms of safety and morale, when making replacement decisions. Safety is the second highly ranked factor while morale is the fourth highly ranked factor. It seems that contractors recognise the importance of safety to their goal achievement as accidents have adverse effect on employees' productivity and expenditure, and company image in the industry. The environmental responsibility factor is ranked the last in the evaluation process. The lack of a clear environmental policy may motivate contractors to assign little importance to environmental responsibility factor.

## Quantitative Factors that Influence Replacement Analysis

As part of the analysis of the replacement proposals, contractors were found to utilize several factors for each proposed alternative. The contractors use these factors to compare and evaluate alternative proposals for selecting the most appropriate alternative. These quantitative factors include inflation, escalation, downtime cost, obsolescence, depreciation, time value of money, salvage value, and cost records. Table 3 illustrates the importance of each of the above factors on the contractors' replacement decisions. The results indicated that contractors consider downtime cost and obsolescence, as the prime and the most influential factors on the replacement decision. The downtime cost is the cost that arises from an equipment failure. It can be divided into two categories. The first category is the tangible cost of labour, material, and other resources needed to repair the equipment. The second category includes all the intangible or consequential costs that arise from the failure, and that includes loss of production cost, delay or impact on the schedule, and any other impacts on the organisation as a whole.

| Quantitative Evaluation Factor | Score | | | | | Sum | Rank |
|---|---|---|---|---|---|---|---|
| | VMJI | MJI | MNI | VMNI | NI | | |
| | 5 | 4 | 3 | 2 | 1 | | |
| Inflation | 1 | 2 | 6 | 7 | 3 | 48 | 7 |
| Escalation | 1 | 3 | 7 | 7 | 1 | 53 | 6 |
| Downtime Costs | 12 | 5 | 3 | 0 | 0 | 89 | 1 |
| Obsolescence | 5 | 11 | 3 | 2 | 0 | 82 | 2 |
| Depreciation | 4 | 9 | 4 | 4 | 0 | 76 | 3 |
| Time Value of Money | 4 | 6 | 5 | 3 | 2 | 67 | 4 |
| Salvage Value | 0 | 5 | 12 | 3 | 0 | 62 | 5 |

*VMJI: Very Major Influence, MJI: Major Influence, MNI: Minor Influence, VMNI: Very Minor Influence, NI: No Influence*

*Table 3:* Quantitative evaluation factors

Obsolescence is the increase on the operating cost and a decrease on the resale value of equipment. Most of the participants consider equipment obsolete when it exceeds its economic life. The risk of equipment failure increases after its economic life. Operating equipment after its economic life has passed may have a substantial economical impact on the contractor's business. About one third of the participants also consider equipment as obsolete when the dealer is out of business or when he terminates technical support for such equipment. The vision towards new equipment is not a significant factor for characterising current equipment as obsolete.

The contractors were found to discard their equipment at different rates. The majority (about 52%) and another (25%) of the participants use an obsolescence rate of about 10% and between 11 to 15%, respectively. These rates are considered very high indicating that contractors search for and purchase new models of construction equipment.

Also, contractors are conscious of the time-value of money and equipment salvage value when they evaluate alternatives. Time value of money is the consideration of time when analysing the costs and rewards of equipment. Cash flow method is a good example of using the time adjusted expenses and benefits.

The salvage value is an expected value for the future worth of the equipment at its disposal time. It seems that contractors who are attracted by new models consider resale value as a factor in the equipment replacement decision. The contractor may use the resale amount for financing the purchase of new models.

There are many ways of disposing of equipment. The results indicate that auction is the most attractive and selling to others is the second attractive mode for disposing off equipment. Auction is common because it gives both sellers and buyers a fair platform for transaction.

Depreciation is a measure of the loss in the value of the equipment over time due to wear and tear from use, deterioration, obsolescence, and reduced need. The results, as shown in Table 4, indicate that contractors in Saudi Arabia use the straight line and percent life methods for depreciating their equipment. The popularity of these methods emerges from their simplicity and fairness.

| Depreciation Accounting Method | Number of Contractors | Percent |
|---|---|---|
| Straight Line | 11 | 52.38 |
| Double Declining balance | 1 | 4.76 |
| Sum of Years digits | 1 | 4.76 |
| Percent of Life | 8 | 38.10 |

*Table 4:* Depreciation accounting method

Inflation is the annual decrease in the value of money or the additional money on the real price of the equipment due to reduced value of the currency. This factor has very little impact on contractors' equipment replacement decision. The economy in Saudi Arabia is very stable, and the inflation rate is very much controlled to less than 3% annually. Also, inflation and escalation are subsets of time value and may thus explain their lower rank.

## Financial Analysis of Equipment Replacement Proposals

Once all the values of the quantitative factors are collected and arranged, the contractor conducts an economic analysis. In this analysis, he compares the actual and expected expenses and revenues of each alternative over a pre-defined time span for determining the best replacement proposal. The results indicate that the majority of the participants compare net cash flows of alternatives, and only 19% of the contractors use the disbursements on the comparison.

The contractors use receipts of various proposals which can be found using any of the methods listed in Table 5. About 57% of the participants calculate internal rates based on in-house data while 28% directly allocate revenues to equipment proposals. These two methods are the commonly used ones while others are rarely used.

| Determination of Proposals Receipts | Number of Contractors | Percent |
|---|---|---|
| Directly allocate revenue to equipment investment | 6 | 28.57 |
| Use rental rates from local equipment dealers | 2 | 9.52 |
| Using rental rates as suggested by governmental agencies | 0 | 0 |
| Calculating internal rates based on in-house data | 12 | 57.15 |
| No Response | 1 | 4.76 |

*Table 5:* Determination of proposals receipts

During the financial evaluation of the equipment replacement proposals, the common practice is to translate all the collected information into sensible numbers and figures for making the comparison fair and meaningful. The contractor starts the analysis by establishing a cash flow for each alternative. The money spent or gained on an alternative investment is presented in cash flow diagrams. Based on a predefined direction from the contractor top management, the team sets the minimum acceptable rate of return (MARR), which is a cut-off return representing the yield on investments that is considered as a minimum acceptable return. Over the years there has been much discussion about how to select the minimum rate of return. Unfortunately, a completely satisfactory method for precisely determining this rate is yet to be offered. Because the rate that is selected represents the firm's profit objectives, it is usually based on the judgment of the firm's senior management. This judgment is in turn based on the management's view of the firm's future opportunities along with the firm's financial situation (Thuesen and Fabrycky, 1993). Table 6 presents the methods commonly used to determine the minimum rate of return, and the participant's distribution among the methods. About 42% of the participants use management to determine the target rate of return method and about 28% use their historical rate of return. The cost of specific source of fund and the weighted cost of source of funds methods are not commonly used.

| Method of Determining the Minimum Rate of Return | No. of Contractors |
|---|---|
| Cost of Specific Source of Funds | 2 |
| Weighted Cost of Sources of Funds | 2 |
| Management Determines Target Rate of Return | 9 |
| Firm's Historical Rate of Return | 6 |
| No Response | 2 |

*Table 6:* Determination of the minimum rate of return

Selecting the proper minimum rate of return is very important for it can impact the selection of the best equipment replacement alternative. If the selected minimum rate of return is too high, many proposals that have good returns may be rejected. On the other hand, a rate that is too low may allow the acceptance of proposals that are marginally productive or result in an economic loss.

The team assumes that all alternatives have the same time span for comparison. The time span over which alternatives to be compared is usually referred to as the study period or the planning horizon. This study period may be set by the company policy or it may be determined by the time span over which reasonably accurate cash flow estimates can be a basis for determining the study period. Then, the team uses one method for analyzing the different alternatives of cash flow.

## Financial Evaluation of Equipment Replacement Proposals

Net present value, payback period, internal rate of return, annual cost minimisation, total cost minimisation, economic life, and profitability index are methods available for contractors to use in the financial evaluation of the alternatives. The cash flow is normally prepared for each alternative and used as the base to perform the analysis.

The participants, after selecting from a given list of financial replacement methods that they use, assess the criteria that best characterise their practice. Table 7 illustrates the extent of use and the characteristics of each method.

| **Criteria** | Number of Contractors | | | | | | |
|---|---|---|---|---|---|---|---|
| | Financial Replacement Method | | | | | | |
| | **NPV** | **PBP** | **IRR** | **TCM** | **EL** | **PI** | **ACM** |
| Simplicity | 1 | 7 | 2 | 2 | 7 | 0 | 0 |
| Availability of input data | 3 | 5 | 3 | 0 | 6 | 0 | 0 |
| Excessive knowledge of accounting | 2 | 0 | 0 | 0 | 3 | 0 | 0 |
| Availability of a guideline range | 1 | 1 | 1 | 1 | 3 | 0 | 0 |
| Measure a future risk period | 2 | 4 | 0 | 1 | 4 | 0 | 0 |
| Measure rate of return | 4 | 5 | 2 | 0 | 5 | 0 | 0 |
| Measure worth of bids | 3 | 1 | 2 | 1 | 3 | 0 | 0 |
| Consider time value of money | 3 | 0 | 1 | 1 | 3 | 0 | 0 |
| Consider expected salvage value | 2 | 1 | 2 | 1 | 2 | 0 | 0 |
| Consider obsolescence and deterioration | 2 | 3 | 0 | 1 | 5 | 0 | 0 |
| Determine expected economic life | 3 | 3 | 2 | 1 | 9 | 0 | 0 |
| **Overall Method Value** | | | | | | | |

*Legend:*
*NPV: Net Present Value Method, PBP: Payback Period Method, IRR: Internal Rate of Return Method, TCM: Total Cost Minimisation Method, EL: Economic Life Method. PI: Profitability Index Method, ACM: Annual Cost Minimisation Method.*

*Table 7:* Extent of use of the financial methods

The results indicate that the majority of contractors use payback period, economic life, and net present value methods in the financial equipment replacement analysis. The payback period (PBP) is the period of time after which the investor will recover his money back or the time required until the equivalent revenues exceed the equivalent capital overlays. The prime objective of the method is to measure how many years the invested money will be at risk. Normally for considering the worth of investment of equipment, the company will set a predetermined number of years, where the proposed equipment payback period should be less than or equal to that predetermined number. The users of this method indicate that they use it because it is simple, does not require excessive background in accounting, and it provides them with measures of rate of return, future risk period, and the expected economic life based on available input data and equipment obsolescence.

Economic life (EL) is the optimum replacement period or the minimum cost life where the total annual equivalent revenues will be higher than the total annual equivalent expenses. Generally, the equipment manufacturer estimates the economic life for the equipment by providing the equipment performance curve. However, this duration is significantly dependent on the equipment use and the company's maintenance program and national economy (Jaafari and Mateffy, 1990). The users of this method indicate that they use it because it is simple and does not require excessive background in accounting; and it produces measures for the expected economic life, rate of return, future risk period, and worth of bids based on available input data including equipment obsolescence.

Net present value (NPV) is the net equivalent amount at the present time that represents the difference between the equivalent expenses and the equivalent revenues for an alternative cash flow for selected interest rate and investment duration. The prime objective of the method is to indicate if the alternative is profitable, and worth the investment or not. If the proposal NPV is positive, it promises an acceptable rate of return and hence considered profitable. If the NPV is negative, the proposal is considered non-profitable. The users of this method indicate

that they use it because it produces measures for rate of return, the expected economic life, future risk period, and worth of bids based on available input data; including equipment obsolescence and salvage value. In general, the NPV is used only to indicate if the alternative is profitable or not, and never used to make replacement decisions (Thuesen and Fabrycky, 1993). In general the PBP method is used to calculate the period the invested money will be at risk, and to estimate the number of years after which the investor will recover his money back.

The survey results indicate that three participants, as shown in Table 7, use the internal rate of return (IRR) method. IRR is the interest rate that causes the equivalent revenues of a cash flow to be equal to the equivalent expenses. In other words, it is the interest rate that reduces the present worth of a series of revenues and expenses for the cash flow to zero. In economics, IRR represents the percentage or rate earned on the unrecovered balance of the investment. In general, IRR method is used to calculate the minimum expected rate of return for the investment proposals over the investment period.

None of the participants, as shown in Table 7, uses the annual cost minimisation (ACM) method, which can be defined as finding the annual equivalent of all costs associated with an alternative and selecting the alternative that has the minimum annual cost. ACM considers only the associated costs, and does not pay any attention to the revenues that might be gained from the equipment utilisation. This is one of the major disadvantages of the ACM method that reduces its utilisation.

The total cost minimisation (TCM) method can be defined as the sum of all the costs for equipment over the investment period, and then selecting the alternative that has the minimum total cost. The survey results indicate that two participants use the TCM method. Simplicity and availability of data are among the high characteristics of the method. The required input data for the TCM method are the expenses, the investment period, and the interest rate. The expenses are the variables that need to be equated. Inputs to estimate these expenses are needed from the manufacturer and the company that will be using the equipment. Both participants that are using TCM indicated that this method requires excessive knowledge of accounting.

The profitability index (PI) is the ratio of the net cash flow to the amount of money invested to buy the equipment. This method is normally used to rank the replacement alternatives. None of the participants use this method.

The input data from the participants on the effectiveness of each financial evaluation method are plotted in Figure 1. It can be noted that the EL method has the highest number of users and the highest number of points, and therefore can be considered the most commonly used method for evaluating the equipment replacement proposals.

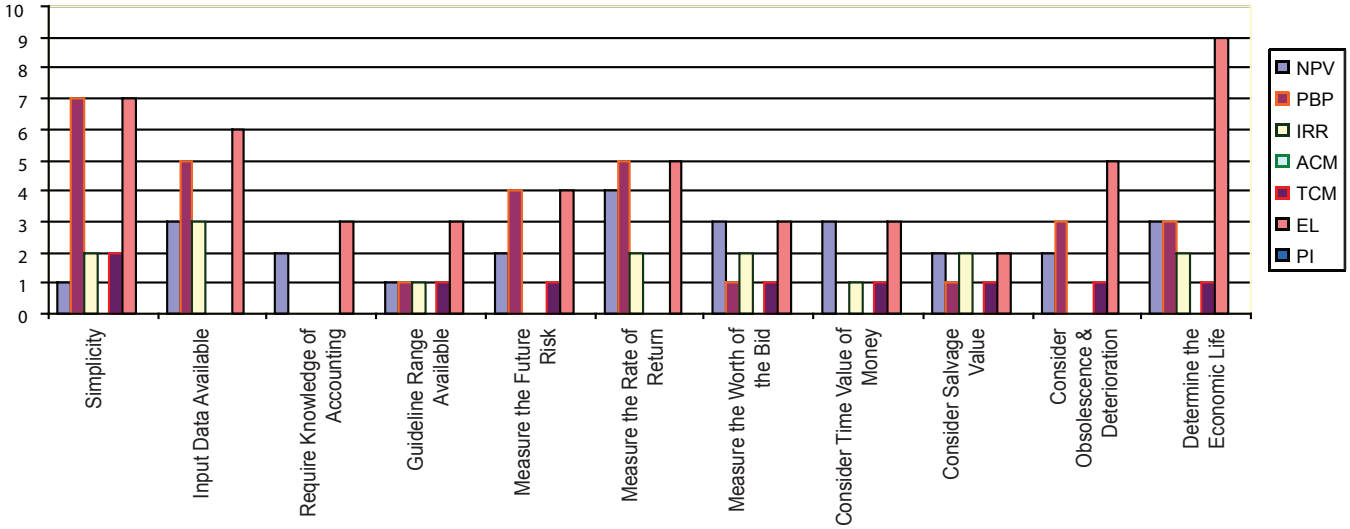


*Figure 1:* Effectiveness of financial evaluation methods

## Use of Software Programs for Replacement Analysis

Computers are used nowadays in almost every field. Software programmers are always looking for ways to reduce time, resources, and the cost of doing routine and mathematical activities that can be taken care of by software programs. Software programs also help in ensuring accurate and correct calculations. Nowadays codes and programs can be written for replacement models, that facilitate and reduce the time and effort in performing the replacement analysis process. It is found that only two contractors from Grade III use software programs for the replacement analysis. This finding clearly indicates that contractors in Saudi Arabia are not taking full advantage of computers and computer programs in improving their performance, and optimising the utilisation of their resources. The low use of computers in replacement decision making might be due to the very low frequency for replacing equipment, and to the unavailability of good software models that have proven to be effective for this type of analysis.

## CONCLUSION

Construction contractors in the Eastern Province of Saudi Arabia own about 83% of the equipment fleet they use in construction projects. Replacing a piece of equipment requires that the contractors study different alternatives including remodeling existing equipment, purchasing new equipment, purchasing used equipment, and keeping existing equipment. Each alternative was evaluated based on qualitative and quantitative factors. The management goals, employees' safety and morale, and image of contractor in the industry and competitors are considered qualitatively for each alternative. The contractors quantify downtime cost, salvage value, obsolescence, escalation, time value of money, and depreciation for each alternative before developing a cash flow scheme for economic analysis. In this analysis, the contractors compare the actual and expected expenses with the revenues of each alternative. Payback period, net present value, and economic life are the most popular

techniques that contractors use for calculating measures for selecting the best alternative for the contractor. The analysis is mostly carried out manually without utilising computers and related software.

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